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PANASONIC CT-20G4 TECHNICAL SERVICE DATA

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SAFETY PRECAUTIONS

SERVICE WARNING

Only qualified service technicians who are familiar with safety checks and guidelines should perform service work. Before replacing parts, disconnect power source to protect electrostatically sensitive parts. Do not attempt to modify any circuit unless so recommended by the manufacturer. When servicing the receiver, use an isolation transformer between the line cord and power receptacle.

SERVICING THE HIGH VOLTAGE AND CRT

Use EXTREME CAUTION when servicing the high voltage circuits. To discharge static high voltage, connect a 10K ohms resistor in series with a test lead between the receiver and CRT anode lead. DO NOT lift the CRT by the neck. Always wear shatterproof goggles when handling the CRT to protect eyes in case of implosion.

X-RAY RADIATION AND HIGH VOLTAGE LIMITS

Be aware of the instructions and procedures covering X-ray radiation. In solid-state receivers and monitors, the CRT is the only potential source of X-rays. Keep an accurate high voltage meter available at all times. Check meter calibration periodically. Whenever servicing a receiver, check the high voltage at various brightness levels to be sure it is regulating properly. Keep high voltage at rated value, NO HIGHER. Excessive high voltage may cause X-ray radiation or failure of associated components. DO NOT depend on protection circuits to keep voltage at rated value. When troubleshooting a receiver with excessive high voltage, avoid close contact with the CRT. DO NOT operate the receiver longer than necessary. To locate the cause of excessive high voltage, use a variable AC transformer to regulate voltage. In present receivers, many electrical and mechanical components have safety related characteristics which are not detectable by visual inspection. Such components are identified by a # on both the schematic and the parts list. For SAFETY, use only equivalent replacement parts when replacing these components.

GENERAL GUIDELINES

Perform a final SAFETY CHECK before returning receiver to customer. Check repaired area for poorly soldered connections, and check entire circuit board for solder splashes. Check inner board wiring for pinched wires or wires contacting any high wattage resistors. Check that all control knobs, shields, covers, grounds, and mounting hardware have been replaced. Be sure to replace all insulators and restore proper lead dress.

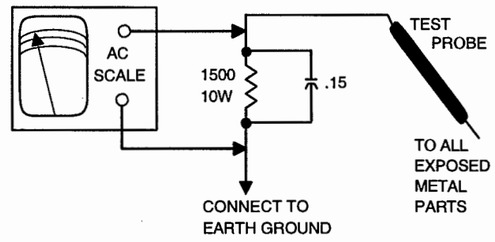
SAFETY CHECKS -- FIRE AND SHOCK HAZARD

Cold Leakage Checks for Receivers with Isolated Ground

Unplug the AC cord, connect a jumper across the plug prongs, and turn the power switch on (if applicable). Use an ohmmeter to measure the resistance between the jumped AC plug and any exposed metal cabinet parts such as antenna screw heads, control shafts, or handle brackets. Exposed metal parts with a return path should measure between 1M ohms and 5.2M ohms. Parts without a return path must measure infinity.

Hot Leakage Current Check

Plug the AC cord directly into an AC outlet. DO NOT use an isolation transformer. Use a 1500 ohms, 10W resistor in parallel with a .15µF capacitor to connect between any exposed metal parts on the receiver and a good earth ground. (See figure below.) Use an AC voltmeter with at least 5000 ohms per volt sensitivity to measure the voltage across the resistor. Check all exposed metal parts and measure voltage at each point. Voltage measurements should not exceed .75VAC, 500µA. Any value exceeding this limit constitutes a potential shock hazard and must be corrected. If the AC plug is not polarized, reverse the AC plug and repeat exposed metal part voltage measurement at each point.



TEST JIG HOOKUP

Function	Chek-A-Color Adapter No.	PC Board Plug No.	Pin	Color
CRT	B239	DY	1	Green
Yoke	D482		2	Yellow
Yoke Setting	YP2A		4	Red
Comments	Focus Tap		6	Blue

HORIZONTAL OSCILLATOR DISABLE TEST

Place a jumper between pins 3 and 4 of IC803. Connect a high voltage probe to the CRT anode. Set the AC supply to 45VAC. Turn the receiver on and slowly increase the AC supply. Confirm the high voltage does not exceed 35.5kV when the horizontal just begins to pull out of sync. If the high voltage should exceed 35.5kV or the receiver fails to lose horizontal sync, refer to the "Horizontal Oscillator Disable" section of the Troubleshooting guide. Remove jumper.

The listing of any available replacement part herein in no case constitutes a recommendation, warranty, or guarantee by Howard W. Sams & Company as to the quality and suitability of such replacement part. The numbers of the listed parts have been compiled from information furnished to Howard W. Sams & Company by the manufacturers of the specific type of replacement part listed.

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PHOTOFACT® Technical Service Data

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For Supplier Address,
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PANASONIC

Model CT-20G4A (Chassis AP327)

Essential coverage for servicing a television receiver...

- Schematics
- Component locations
- Parts list

Coverage includes these additional models and chassis:

MODELS	CHASSIS
CT-20G14A	XEP326
CT-20G14DA	DP326
CT-20G24A	DP330
CT-20G24DA	DP330
CT-20G34A	AP326
CT-2013SA	AP327

HOWARD W. SAMS & COMPANY

SEPTEMBER 1999 SET 4187

4187

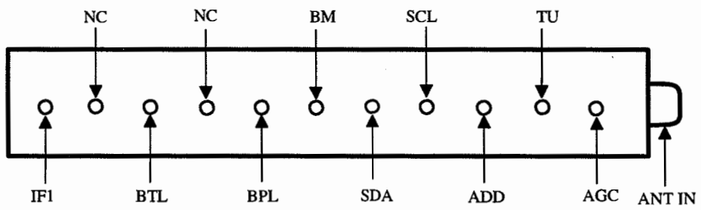
TUNER INFORMATION

TUNER VOLTAGE CHART

Pin	VHF Low Band	VHF High Band	UHF Band
AGC	4.1V	5.2V	4.2V
TU	1.1V	4.4V	4.6V
ADD	0V	0V	0V
SCL	4.2V	4.2V	4.2V
SDA	4.2V	4.2V	4.2V
BM	9.0V	9.0V	9.0V
BPL	5.0V	5.0V	5.0V
NC	0V	0V	0V
BTL	4.2V	7.4V	7.5V
NC	0V	0V	0V
IF1	0V	0V	0V

NOTE: VHF Low Band voltages taken on channel 2.
VHF High Band voltages taken on channel 7.
UHF Band voltages taken on channel 14.

TUNER TERMINAL GUIDE



TEST EQUIPMENT

Test equipment listed by participating manufacturer illustrates typical or equivalent equipment used by Sams engineers to obtain measurements. This equipment is compatible with most types used by field service technicians.

Equipment	Sencore No.	Equipment	Sencore No.
Oscilloscope	SC3100	Isolation Transformer	PR570
Generators		Capacitance Analyzer	LC102
RGB	CM2125	CRT Analyzer	CR7000
Multiburst Signal	VG91	AC Leakage Tester	PR570
Color Bar	VG91	Inductance Analyzer	LC102
TV Stereo	VG91	Flyback Yoke Tester	TVA92
Digital VOM	SC3100	Field Strength Meter	SL753
Frequency Meter	SC3100	Transistor Tester	TF46
Hi-Voltage Probe	HP200	Horizontal Analyzer	HA-2500
Accessory Probes	TP212	Video Analyzer	VG91, TVA92

MISCELLANEOUS ADJUSTMENTS

NOTE: This receiver employs digital customer controls. All adjustments are at normalized position unless otherwise indicated.

B+ CHECK

Connect a digital DC voltmeter to pin 2 of T801 and the common tie point. Set brightness and picture to minimum. With AC line voltage set to 120VAC, B+ should read 130V* ±1.0V*.

* Taken from a common tie point.

HIGH VOLTAGE CHECK

Tune in a picture. Set brightness and picture for a black raster. Connect a high voltage probe to CRT anode. High voltage should read 26kV to 28kV.

PURITY CHECK

Press recall button on remote transmitter to enter purity check mode.

NOTE: Receiver must be in serviceman mode for purity colors to display on screen. Press recall button to cycle through white, red, green, blue, and normal screens.

PURITY

Enter serviceman mode. See "Purity Check" to display a green raster. Loosen deflection yoke and move it back as far as possible. Loosen locking ring and move the purity tabs to center the vertical green band. Slowly slide the deflection yoke forward until a uniform green screen is obtained.

CONVERGENCE

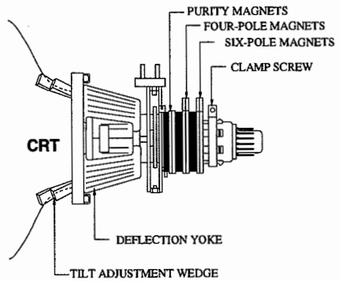
Connect a signal generator to antenna terminal and tune in a dot pattern. Adjust the 4-pole magnets to converge the red and blue dots at the center of the screen. Adjust the 6-pole magnets to converge the red/blue dots over the green dots at the center of the screen.

NOTE: Spread the two tabs of each set of magnets equally and opposite to converge vertically, and rotate both tabs in the same direction to converge horizontally. Since the four and six pole magnets interact, repeat the adjustment until center convergence is correct.

Tune in a crosshatch pattern. Remove rubber wedges between the deflection yoke and CRT. Tilt deflection yoke up or down to converge the vertical lines at the top and bottom of the screen and the horizontal lines at the left and right sides of the screen. Tilt the deflection yoke left or right to converge the horizontal lines at the top and bottom of the screen and the vertical lines at the left and right sides of the screen. Repeat convergence procedure if necessary to obtain the best overall convergence. Replace rubber wedges.

If the yoke or CRT is replaced, a magnet correction strip (Part No. 0FMK014ZZ) may be required to match the yoke and CRT for optimum convergence. Position the strip between the CRT and yoke for best convergence at corners of screen and secure with tape.

CRT NECK ASSEMBLY



ENTERING SERVICEMAN MODE

Turn the receiver on and momentarily short pins 3 and 8 of connector TP. In the upper left side of the picture, CHK is displayed in yellow. Press the action and volume up buttons on the receiver. The CHK display turns red. The serviceman mode is indicated by CHK displayed in red at the upper left side of the picture.

Press the power button on the remote or the action and volume down buttons on the receiver repeatedly to select one of six service modes.

B = DAC Adjustments
C = CRT Adjustments
S= Factory Adjustments for PIP and Clock
M = Stereo Adjustments
X = Comb Filter Adjustments
CHK = Normal operation of channel and volume buttons.

EXIT SERVICEMAN MODE

NOTE: Always exit serviceman mode when finished making adjustments.

Press action and power buttons on receiver control panel simultaneously for approximately 2 seconds to exit serviceman mode. The receiver will display a self check menu with audio on channel 3.

DAC ADJUSTMENTS

NOTE: Write down original values in detail before making any adjustments in case a misadjustment occurs. Press channel up or down buttons on remote to select any of adjustment addresses. Press volume up or down buttons on remote to change level of adjustment.

DAC Adjustment Range and Default Levels

Adjustment	Range	Default Level	On-Set Level
Sub Color (B0)	0-63	27	25
Sub Tint (B1)	0-63	44	43
Sub Brightness (B2)	0-255	56	66
Sub Contrast (B3)	0-63	27	29
Killer/ABL/Gamma (B4)	0-7	5	5
Video Adjustment (B5)	0-15	9	9
Audio Adjustment (B6)	0-31	15	14
Vertical Size (B7)	0-63	37	23

Sub Color (B0)

Tune in a color bar signal. Connect oscilloscope to pin 1 of connector C1 on the CRT board. Connect TPD2 to ground. Enter serviceman mode and select DAC adjustment. Select sub color (B0). Adjust waveform for .9Vp-p ±.05Vp-p.

Sub Tint (B1)

Tune in a color bar signal. Connect oscilloscope to pin 1 of connector C1 on the CRT board. Connect TPD2 to ground. Enter serviceman mode and select DAC adjustment. Select sub tint (B1). Adjust waveform so the 1st and 4th peaks are of equal amplitude.

Sub Brightness (B2)

This adjustment must be made after sub picture and color temperature adjustments are made. DO NOT adjust screen after sub brightness is set. Connect a color bar signal with pure white and pure black to the antenna input. Set color to minimum. Enter serviceman mode and select DAC adjustment. Select sub brightness (B2). Adjust until the black bars start to turn gray, then decrease adjustment until bars turn black.

Sub Contrast (B3)

NOTE: This adjustment is factory set, DO NOT adjust unless CRT or CRT board is replaced.

Connect a color bar signal to the antenna input. Connect oscilloscope to pin 2 of connector C1 on CRT board. Connect TPD2 to ground. Enter serviceman mode and select DAC adjustment. Select sub contrast (B3). Adjust for 2.8Vp-p ± .1Vp-p from white to black level. Do not include sync tip in measurement.

Video Adjustment (B5)

Connect a color bar signal to the antenna input. Connect oscilloscope to pin 32 of IC101. Enter serviceman mode and select DAC adjustment. Select video adjustment (B5). Adjust for 1.0Vp-p ± .05Vp-p.

Audio Adjustment (B6)

NOTE: This adjustment is factory set, do not adjust unless IC002 or IC101 has been replaced.

Connect a generator with a 1kHz mono audio tone to the antenna terminal. Connect an oscilloscope to junction of R202 and R203. Enter serviceman mode and select DAC adjustment. Select audio adjustment (B6). Adjust for .7V ±.2V.

MISCELLANEOUS ADJUSTMENTS continued

CRT ADJUSTMENTS

Follow same procedure used for DAC adjustments.

CRT Adjustment Range and Default Levels

Adjustment	Range	Default Level	On-Set Level
Red Cutoff (C0)	0 0 thru 1 255	0 152	0 169
Green Cutoff (C1)	0-255	64	64
Blue Cutoff (C2)	0 0 thru 1 255	0 131	0 116
Red Drive (C3)	0-127	70	70
Blue Drive (C4)	0-127	57	75
YNR Switch (C5)	0-1	0	0
AFT (C6)	0 0 thru 1 255	1 134	1 112
RF AGC (C7)	0-127	61	62
YNR (C8)	0-7	0	0
Horiz Centering (C9)	0-31	11	12
Beam Limit (Ca)	0-7	4	4
VCJ Test H (Cb)	0-2	2	2

Color Temperature (C0 thru C4)

NOTE: Observe low and high brightness areas of a B/W picture for proper tracking.

Enter serviceman mode and select CRT adjustments. Set the red cutoff (C0), green cutoff (C1), and blue cutoff (C2) for a gray picture. Set the red drive (C3) and blue drive (C4) for correct white areas.

RF AGC (C7)

Tune in a picture. Enter serviceman mode and select CRT adjustments. Decrease the on-set level until snow appears in picture, then increase the data value to a point just past where snow disappears.

Horizontal Centering (C9)

Tune in a crosshatch pattern. Enter serviceman mode and select CRT adjustments. Select horizontal centering (C9) adjustment and adjust crosshatch pattern for correct horizontal centering.

Beam Limit (Ca)

Tune in a picture. Enter serviceman mode and select CRT adjustments. Adjust beam limit for best picture.

STEREO ADJUSTMENTS

All adjustments were made using a MTS TV / stereo generator connected to the antenna terminal. Set the customer controls to normal listening levels and select stereo mode.

Input Level (M0)

Stereo Adjustment Range and Default Levels

Adjustment	Range	Default Level	On-Set Level
Input Level (M0)	0-63	33	33
High Level Separation (M1)	0-63	25	30
Low Level Separation (M2)	0-15	10	7

On generator select pilot, 1kHz audio frequency, and L+R modulating signal. Connect an oscilloscope to pin 22 of IC2201. Enter serviceman mode and select stereo adjustments. Select input level (M0). Adjust the data value for 1Vp-p.

High Level Separation (M1) and Low Level Separation (M2)

On generator select pilot, 300Hz audio frequency, and left modulating signal. Connect an oscilloscope to pin 22 of IC2201. Enter serviceman mode and select stereo adjustments. Select low level separation (M2). Adjust the data value for minimum amplitude of waveform. On generator select 8kHz audio frequency. Select high level separation (M1). Adjust the data value for minimum amplitude of the waveform. Repeat until no further decrease in amplitude can be obtained.

FACTORY ADJUSTMENTS

Factory adjustments for PIP can be entered but no adjustments should be necessary. They are factory set for normal PIP performance. Write original values in case one of the adjustments is changed by mistake. Confirm that the values are as shown for default level.

Factory Adjustment Range and Default Levels

Adjustment	Range	Default Level	On-Set Level
PIP Color (S0)	0-127	80	80
PIP Contrast (S1)	0-127	52	52
Up 1/9 (S2)	0-255	26	26
Down 1/9 (S3)	0-255	146	146
Left 1/9 (S4)	0-255	9	9
Right 1/9 (S5)	0-255	103	103
Up 1/16 (S6)	0-255	27	27
Down 1/16 (S7)	0-255	163	163
Left 1/16 (S8)	0-255	9	9
Right 1/16 (S9)	0-255	118	118
Freerun (Sa)	-	-	-
Clock Adjustment (Sb)	0-255	78	57
PIP Tint (Sc)	0-63	50	50
Loudness Compensation (Sd)	0-63	52	52

PIP Color (S0), PIP Contrast (S1), and PIP Tint (Sc)

Tune in a picture. Enter the serviceman mode and select factory adjustments. Select PIP color (S0). Adjust to match color of the PIP with color of the main picture. Select PIP contrast (S1) and adjust to match contrast of the PIP with contrast of the main picture. Select PIP tint (Sc) and adjust to match tint of the PIP with tint of the main picture.

Clock Adjustment (Sb)

Connect a frequency counter to pin 13 of IC001. Turn receiver off. Record the frequency. Turn the receiver on and enter the serviceman mode and select factory adjustments. Select clock adjustment (Sb). Adjust (Sb) based on the following formula:

$$(Sb) = 128 + .901 \times 1000000\ [244.1406 - \text{pin 13 (measured in Hz)}] \over 244.1406$$

COMB FILTER ADJUSTMENTS

NOTE: Write down original values in detail before making any adjustments in case a misadjustment occurs.

Comb Filter Adjustment Range and Default Levels

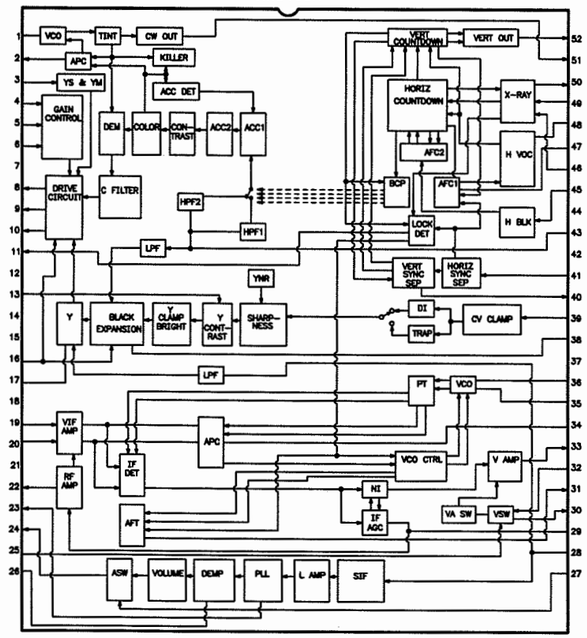
Adjustment	Range	Default Level	On Set Value
Comb Gain (X0)	0 - 255	33	152
Comb Switch (X1)	0 - 63	12	12
Comb Limit (X2)	0 - 63	26	24
Comb Core (X3)	0 - 127	10	41
Comb RF Delay (X4)	0 - 127	78	18
Comb Video Delay (X5)	0 - 127	90	18
Comb VMLM (X6)	0 - 127	34	90
Comb VM SW (X7)	0 - 63	0	24
Comb Charp (X8)	0 - 255	17	67
Comb VM Level (X9)	0 - 255	255	255
Comb VMPKF (Xa)	0 - 1	0	1
Comb Adjust Sharp (Xb)	0 - 63	0	10

CRT PROTECTION

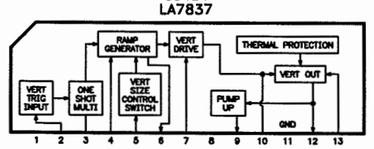
The CRT protection circuit is made up of Q451 and Q452. This circuit blanks out the CRT if vertical deflection failure occurs. It is important for the life of the CRT that this circuit be tested before returning the receiver to the customer. To test, short the base of Q452 to ground. The screen should go blank, if not this circuit needs repair.

IC FUNCTIONS

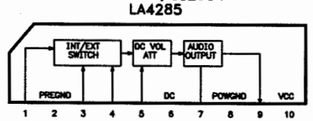
IC101
AN5165K



IC451
LA7837



IC2303, IC2304
LA4285



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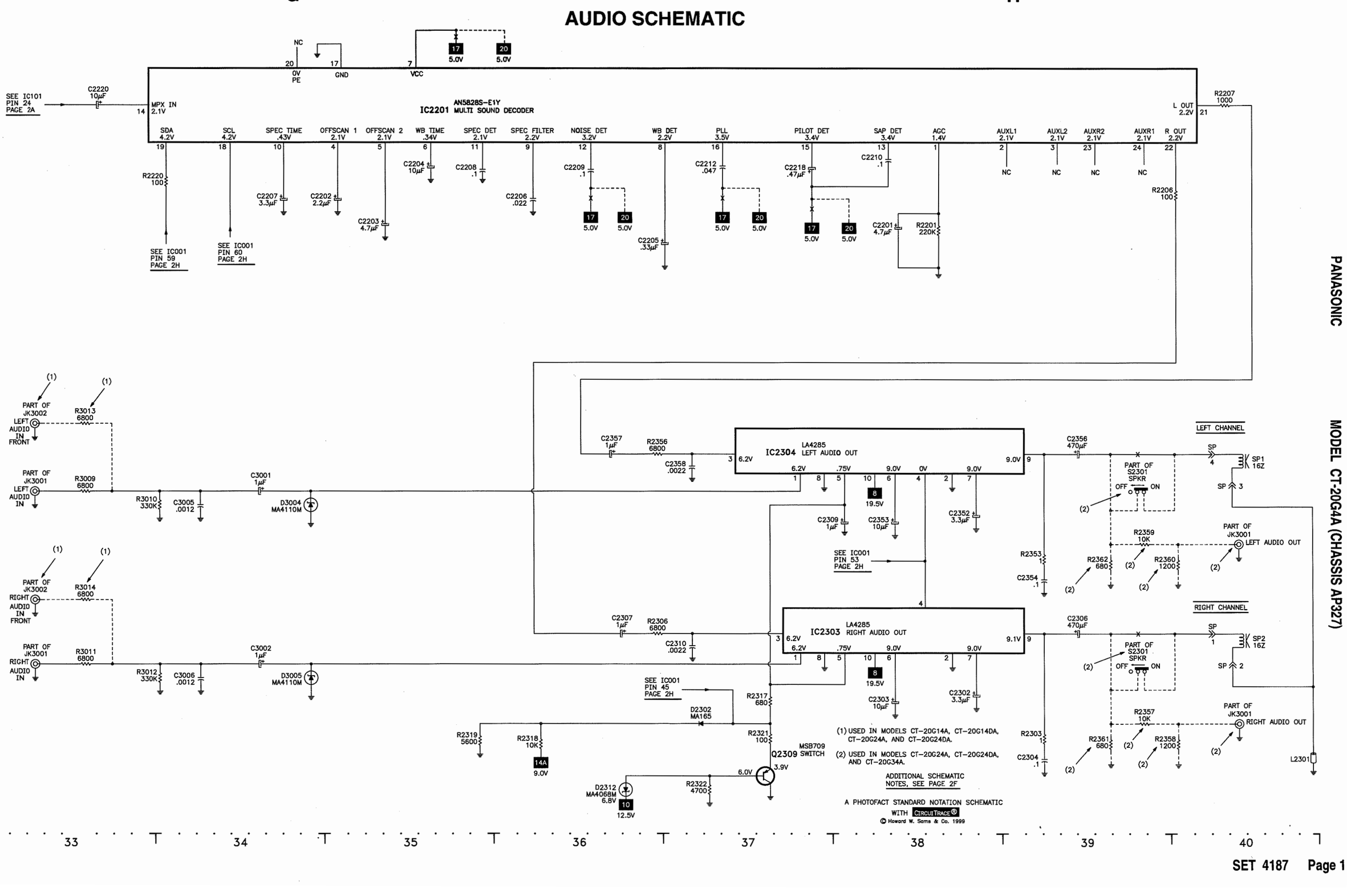
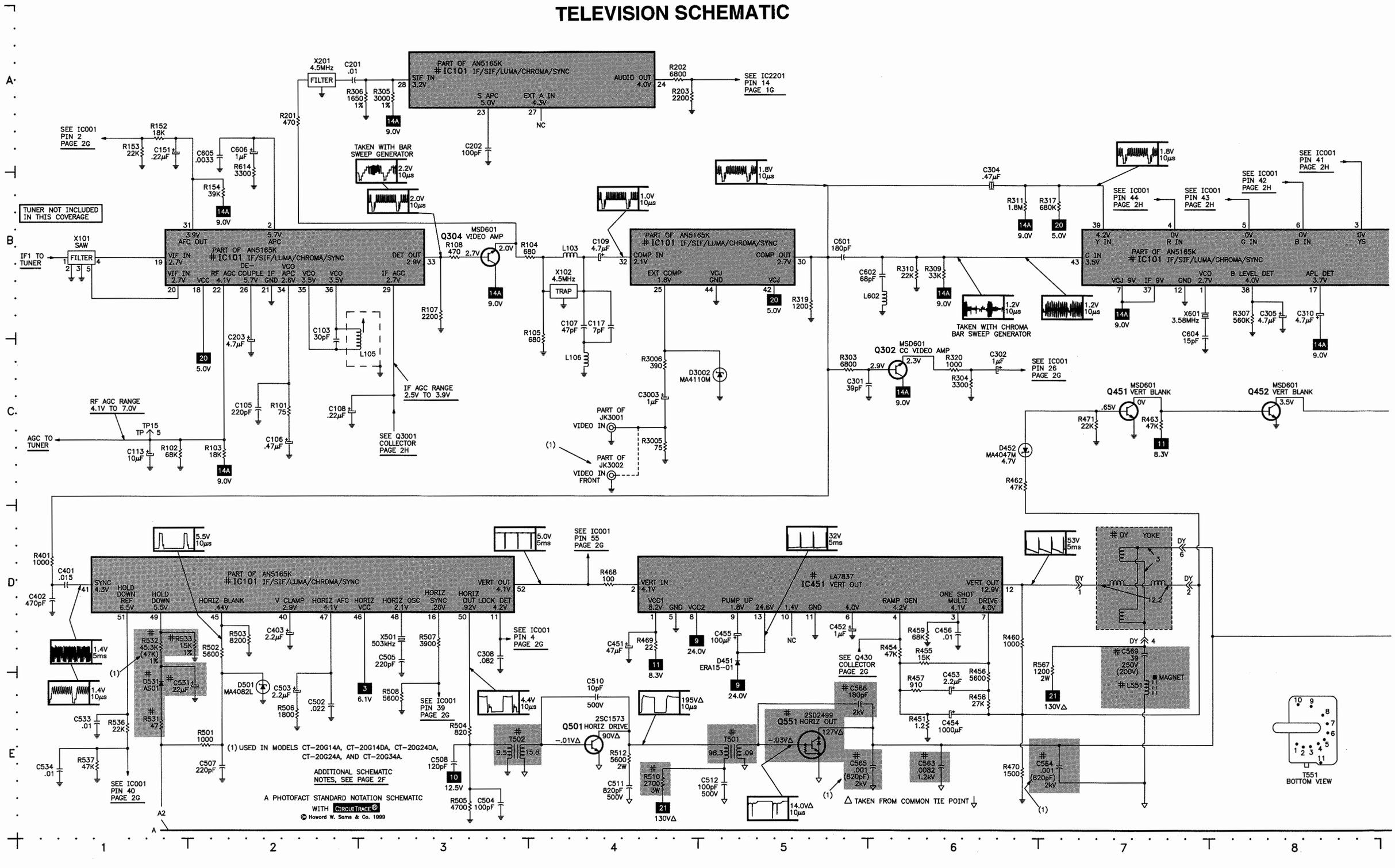
AUDIO SCHEMATIC



PANASONIC

MODEL CT-20G4A (CHASSIS AP327)

TELEVISION SCHEMATIC


PART OF AN5165K
#IC101 IF/SIF/LUMA/CHROMA/SYNC
SEE IC2201 PIN 14 PAGE 1G
SEE IC001 PIN 2 PAGE 2G
TUNER NOT INCLUDED IN THIS COVERAGE
IF1 TO TUNER
X101 SAW FILTER
X201 4.5MHz FILTER
TAKEN WITH BAR SWEEP GENERATOR
Q304 MSD601 VIDEO AMP
X102 4.5MHz TRAP
PART OF JK3001 VIDEO IN
PART OF JK3002 VIDEO IN FRONT
RF AGC RANGE 4.1V TO 7.0V
IF AGC RANGE 2.5V TO 3.9V
AGC TO TUNER
SEE Q3001 COLLECTOR PAGE 2H
TAKEN WITH CHROMA BAR SWEEP GENERATOR
Q302 MSD601 CC VIDEO AMP
SEE IC001 PIN 26 PAGE 2G
Q451 MSD601 VERT BLANK
Q452 MSD601 VERT BLANK
SEE IC001 PIN 41 PAGE 2H
SEE IC001 PIN 42 PAGE 2H
SEE IC001 PIN 43 PAGE 2H
SEE IC001 PIN 44 PAGE 2H
IC451 LA7837 VERT OUT
Q501 HORIZ DRIVE 2SC1573
Q551 HORIZ OUT 2S02499
SEE Q430 COLLECTOR PAGE 2G
SEE IC001 PIN 55 PAGE 2G
SEE IC001 PIN 4 PAGE 2G
SEE IC001 PIN 39 PAGE 2G
SEE IC001 PIN 40 PAGE 2G
(1) USED IN MODELS CT-20G14A, CT-20G14DA, CT-20G24DA, CT-20G24A, AND CT-20G34A.
ADDITIONAL SCHEMATIC NOTES, SEE PAGE 2F
A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE®
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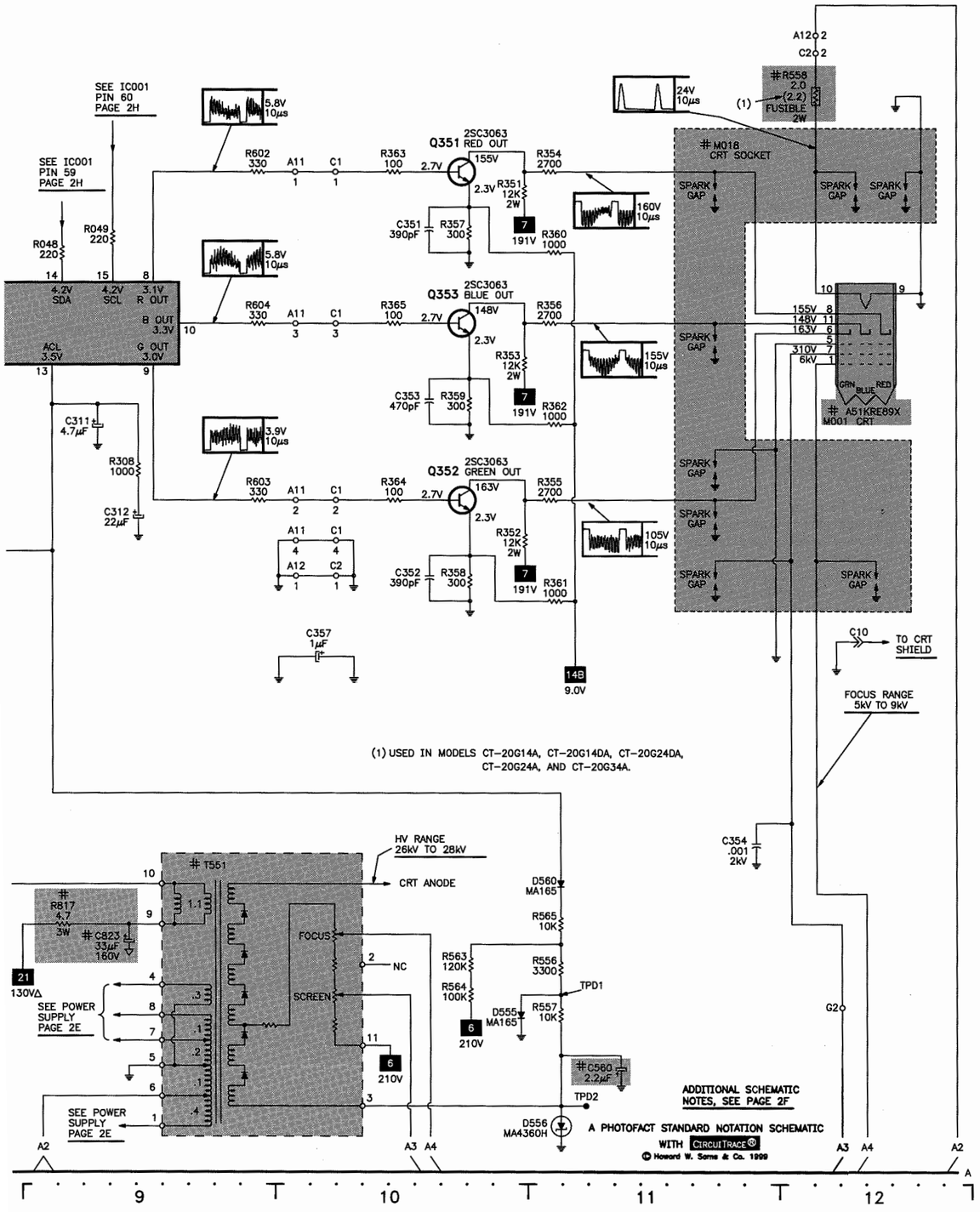
△ TAKEN FROM COMMON TIE POINT
T551 BOTTOM VIEW

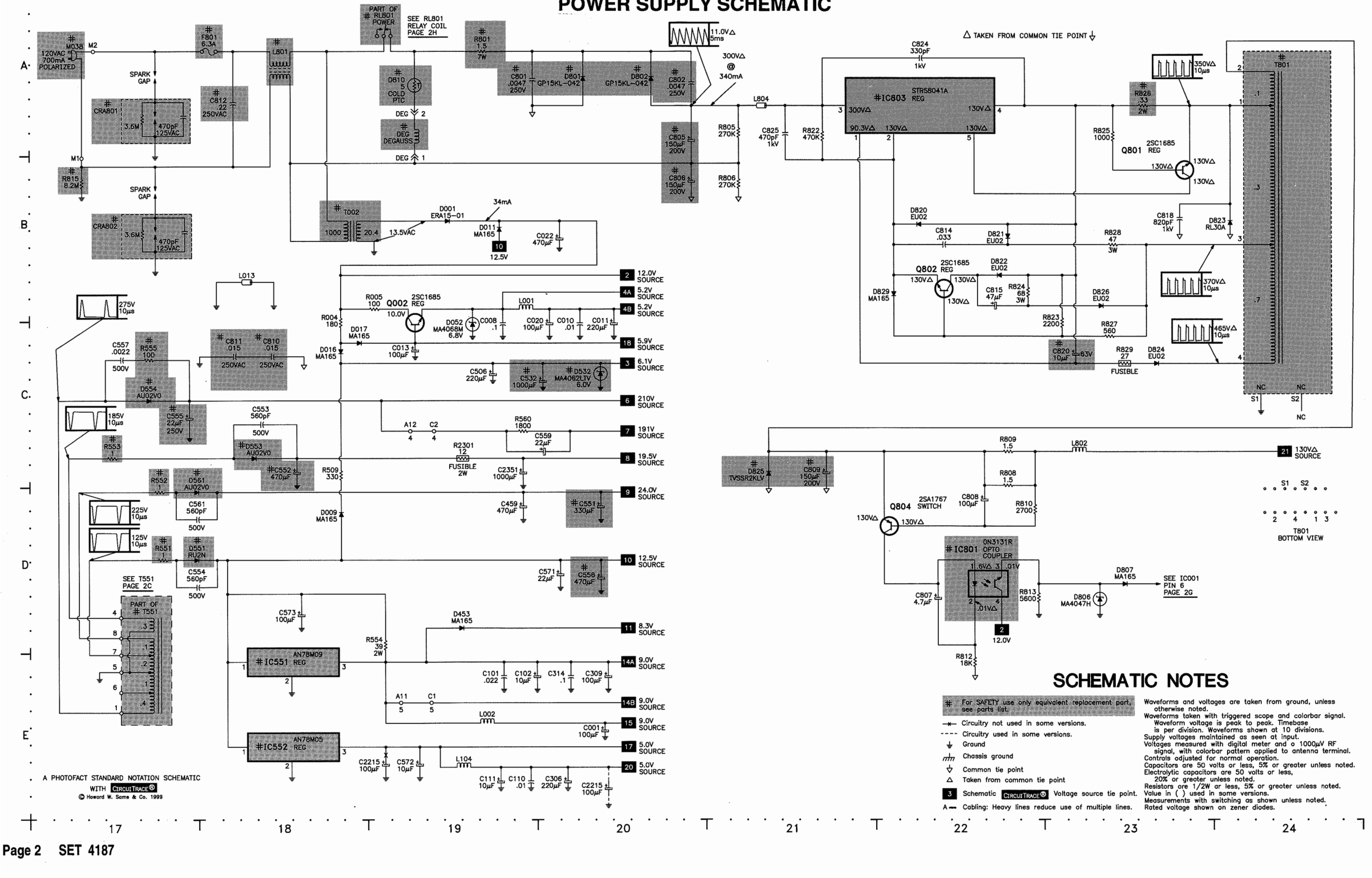
C
TELEVISION SCHEMATIC continued



SCHEMATIC COMPONENT LOCATION GUIDE

(S008)	D-26	C512	E-5	C3005	D-34	L001	C-19	R060	D-28	R532	D-1	S001	B-25
(S009)	C-25	C531	E-2	C3006	E-34	L002	E-19	R065	C-29	R533	D-2	S002	B-25
C001	E-20	C532	C-19	D001	B-19	L003	D-29	R066	C-29	R536	E-1	S003	B-25
C003	B-32	C533	E-1	D002	E-31	L004	C-29	R067	B-29	R537	E-1	S004	B-25
C004	C-30	C534	E-1	D003	E-26	L006	C-32	R068	B-29	R551	D-17	S005	B-25
C005	D-31	C551	D-20	D006	B-31	L008	A-25	R070	D-27	R552	D-17	S2301	D-39
C008	C-19	C552	C-18	D008	B-29	L009	B-31	R101	C-2	R553	C-17	S2301	E-39
C010	C-20	C553	C-18	D009	D-18	L012	C-30	R102	C-1	R554	D-19	SP1	C-40
C011	C-20	C554	D-17	D011	B-19	L013	B-18	R103	C-2	R555	C-17	SP2	D-40
C013	C-19	C555	C-17	D014	C-29	L013	C-31	R104	B-3	R556	E-11	T002	B-18
C016	E-29	C556	D-20	D015	C-30	L103	B-4	R105	C-4	R557	E-11	T501	E-5
C017	A-28	C557	C-17	D016	C-18	L104	E-19	R107	B-3	R558	A-12	T502	E-3
C018	A-27	C559	C-19	D017	C-18	L105	C-2	R108	B-3	R559	B-31	T551	D-9
C019	B-29	C560	E-11	D052	C-19	L106	C-4	R152	A-1	R560	C-19	TP15	C-1
C020	C-20	C561	D-17	D451	D-5	L551	E-7	R153	A-1	R563	E-10	X001	A-27
C022	B-20	C563	E-6	D452	C-6	L602	B-6	R154	B-2	R564	E-10	X101	B-1
C024	D-28	C564	E-7	D453	D-19	L801	A-18	R201	A-2	R565	D-11	X102	B-4
C025	D-28	C565	E-5	D461	C-26	L802	C-23	R202	A-4	R567	E-7	X201	A-2
C026	C-29	C566	E-5	D501	E-2	L804	A-21	R203	A-4	R602	B-9	X501	D-3
C031	C-29	C569	D-7	D531	E-1	L2301	E-40	R303	C-5	R603	C-9	X601	B-7
C032	A-25	C571	D-20	D532	C-20	L2302	D-29	R304	C-6	R604	B-9		
C033	C-30	C572	E-19	D551	D-17	M001	B-12	R305	A-3	R614	B-2		
C035	C-29	C573	D-18	D553	C-18	M038	A-17	R306	A-3	R801	A-19		
C036	C-30	C601	B-5	D554	C-17	Q001	E-30	R307	B-8	R805	A-21		
C037	B-30	C602	B-6	D555	E-10	Q002	C-19	R308	C-9	R806	B-21		
C038	B-30	C604	C-7	D556	E-11	Q003	E-26	R309	B-6	R808	D-22		
C101	E-19	C605	B-2	D560	D-11	Q004	B-29	R310	B-6	R809	C-22		
C102	E-19	C606	A-2	D561	D-17	Q302	C-6	R311	B-6	R810	D-22		
C103	C-2	C801	A-19	D801	A-20	Q304	B-3	R317	B-7	R812	E-22		
C105	C-2	C802	A-20	D802	A-20	Q351	B-10	R319	B-5	R813	D-22		
C106	C-2	C805	B-20	D806	D-23	Q352	C-10	R320	C-6	R815	B-17		
C107	C-4	C806	B-20	D807	D-23	Q353	B-10	R351	B-11	R817	E-9		
C108	C-2	C807	D-22	D810	A-19	Q430	C-27	R352	C-11	R820	D-26		
C109	B-4	C808	D-22	D820	B-22	Q451	C-7	R353	B-11	R821	D-26		
C110	E-19	C809	C-21	D821	B-22	Q452	C-8	R354	B-11	R822	A-21		
C111	E-19	C810	C-18	D822	B-22	Q501	E-4	R355	C-11	R823	C-23		
C113	C-1	C811	C-18	D823	B-24	Q551	E-5	R356	B-11	R824	B-22		
C117	C-4	C812	A-18	D824	C-23	Q801	B-23	R357	B-10	R825	A-23		
C151	A-1	C814	B-22	D825	C-21	Q802	B-22	R358	C-10	R826	A-23		
C201	A-2	C815	C-22	D826	C-23	Q804	D-22	R359	B-10	R827	C-23		
C202	A-3	C818	B-23	D829	B-22	Q2309	E-37	R360	B-11	R828	B-23		
C203	C-2	C820	C-23	D2301	E-30	Q3001	D-30	R361	C-11	R829	C-23		
C301	C-5	C823	E-9	D2302	E-37	R002	B-26	R362	C-11	R2201	B-38		
C302	C-6	C824	A-22	D2312	E-36	R003	E-29	R363	B-10	R2206	B-39		
C304	B-6	C825	A-21	D3001	D-30	R004	C-18	R364	C-10	R2207	A-40		
C305	B-8	C2201	B-38	D3002	C-5	R005	C-18	R365	B-10	R2220	B-34		
C306	E-20	C2202	B-35	D3004	D-34	R006	E-26	R401	D-1	R2301	C-19		
C308	D-3	C2203	B-35	D3005	E-34	R007	D-27	R430	C-27	R2303	E-39		
C309	E-20	C2204	B-35	D3016	A-26	R008	D-27	R432	C-27	R2306	D-36		
C310	B-8	C2205	B-36	DEG	A-19	R010	E-28	R451	E-6	R2311	E-29		
C311	C-9	C2206	B-36	DY	D-7	R011	E-28	R454	D-6	R2312	D-30		
C312	C-9	C2207	B-34	F801	A-17	R012	B-30	R455	E-6	R2313	E-30		
C314	E-20	C2208	B-35	FA1	C-27	R014	C-29	R456	E-6	R2314	E-31		
C351	B-10	C2209	B-36	FA2	C-27	R015	C-30	R457	E-6	R2317	E-37		
C352	C-10	C2210	B-38	IC001	A-28	R016	C-31	R458	E-6	R2318	E-36		
C353	B-10	C2212	B-37	IC002	C-32	R017	D-31	R459	D-6	R2319	E-35		
C354	D-11	C2215	E-19	IC003	A-25	R020	B-29	R460	D-6	R2321	E-37		
C357	C-10	C2215	E-20	IC101	A-3	R021	C-30	R462	C-6	R2322	E-37		
C401	D-1	C2218	B-37	IC101	B-2	R022	D-31	R463	C-7	R2353	D-39		
C402	D-1	C2220	A-33	IC101	B-4	R023	C-28	R465	C-26	R2356	C-36		
C403	D-2	C2302	E-38	IC101	B-7	R025	C-28	R466	C-26	R2357	E-39		
C451	D-4	C2303	E-38	IC101	D-2	R026	B-27	R467	C-26	R2358	E-39		
C452	D-5	C2304	E-39	IC451	D-5	R027	B-27	R468	D-4	R2359	D-39		
C453	E-6	C2306	D-39	IC551	E-18	R028	C-28	R469	D-4	R2360	D-39		
C454	E-6	C2307	D-36	IC552	E-18	R030	D-28	R470	E-6	R2361	E-39		
C455	D-5	C2309	D-38	IC801	D-22	R032	B-26	R471	C-7	R2362	D-39		
C456	D-6	C2310	D-37	IC803	A-22	R033	B-25	R501	E-2	R3001	D-30		
C459	D-19	C2311	E-31	IC2201	A-35	R034	B-25	R502	D-2	R3002	D-29		
C462	C-26	C2351	C-19	IC2303	D-37	R035	B-25	R503	D-2	R3005	C-4		
C502	E-2	C2352	D-38	IC2304	C-37	R036	B-25	R504	E-3	R3006	C-4		
C503	E-2	C2353	D-38	JK3001	C-4	R037	C-25	R505	E-3	R3009	D-33		
C504	E-3	C2354	D-39	JK3001	D-33	R038	C-25	R506	E-2	R3010	D-34		
C505	D-3	C2356	C-39	JK3001	D-40	R039	D-27	R507	D-3	R3011	E-33		
C506	C-19	C2357	C-36	JK3001	E-33	R046	A-26	R508	E-3	R3012	E-34		
C507	E-2	C2358	C-37	JK3001	E-40	R048	B-9	R509	C-18	R3013	C-33		
C508	E-3	C3001	D-34	JK3002	C-33	R049	B-9	R510	E-4	R3014	D-33		
C510	E-4	C3002	E-34	JK3002	C-4	R053	A-29	R512	E-4	RL801	A-19		
C511	E-4	C3003	C-4	JK3002	D-33	R055	A-29	R531	E-1	RL801	E-31		

POWER SUPPLY SCHEMATIC



A PHOTOFACT STANDARD NOTATION SCHEMATIC WITH CIRCUITRACE®

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SCHEMATIC NOTES

For SAFETY use only equivalent replacement part, see parts list.

→← Circuitry not used in some versions.

- - - Circuitry used in some versions.

⏚ Ground

Chassis ground

▽ Common tie point

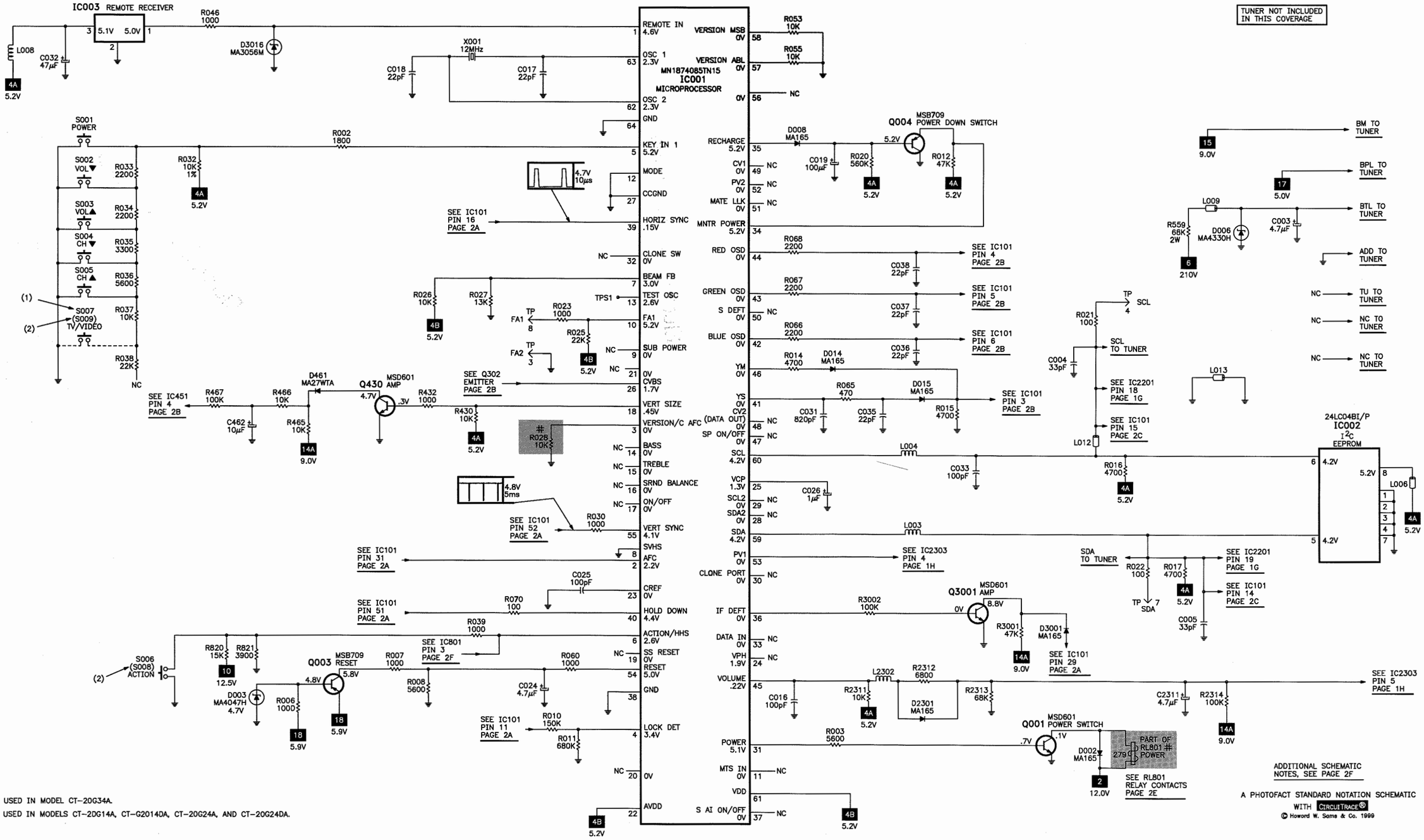
△ Taken from common tie point

3 Schematic CIRCUITRACE® Voltage source tie point.

A Cabling: Heavy lines reduce use of multiple lines.

Waveforms and voltages are taken from ground, unless otherwise noted.
Waveforms taken with triggered scope and colorbar signal. Waveform voltage is peak to peak. Timebase is per division. Woveforms shown at 10 divisions.
Supply voltages maintained as seen at input.
Voltages measured with digital meter and a 1000µV RF signal, with colorbar pattern applied to antenna terminal.
Controls adjusted for normal operation.
Capacitors are 50 volts or less, 5% or greater unless noted.
Electrolytic capacitors are 50 volts or less, 20% or greater unless noted.
Resistors are 1/2W or less, 5% or greater unless noted.
Value in ( ) used in some versions.
Measurements with switching as shown unless noted.
Rated voltage shown on zener diodes.

SYSTEM CONTROL SCHEMATIC



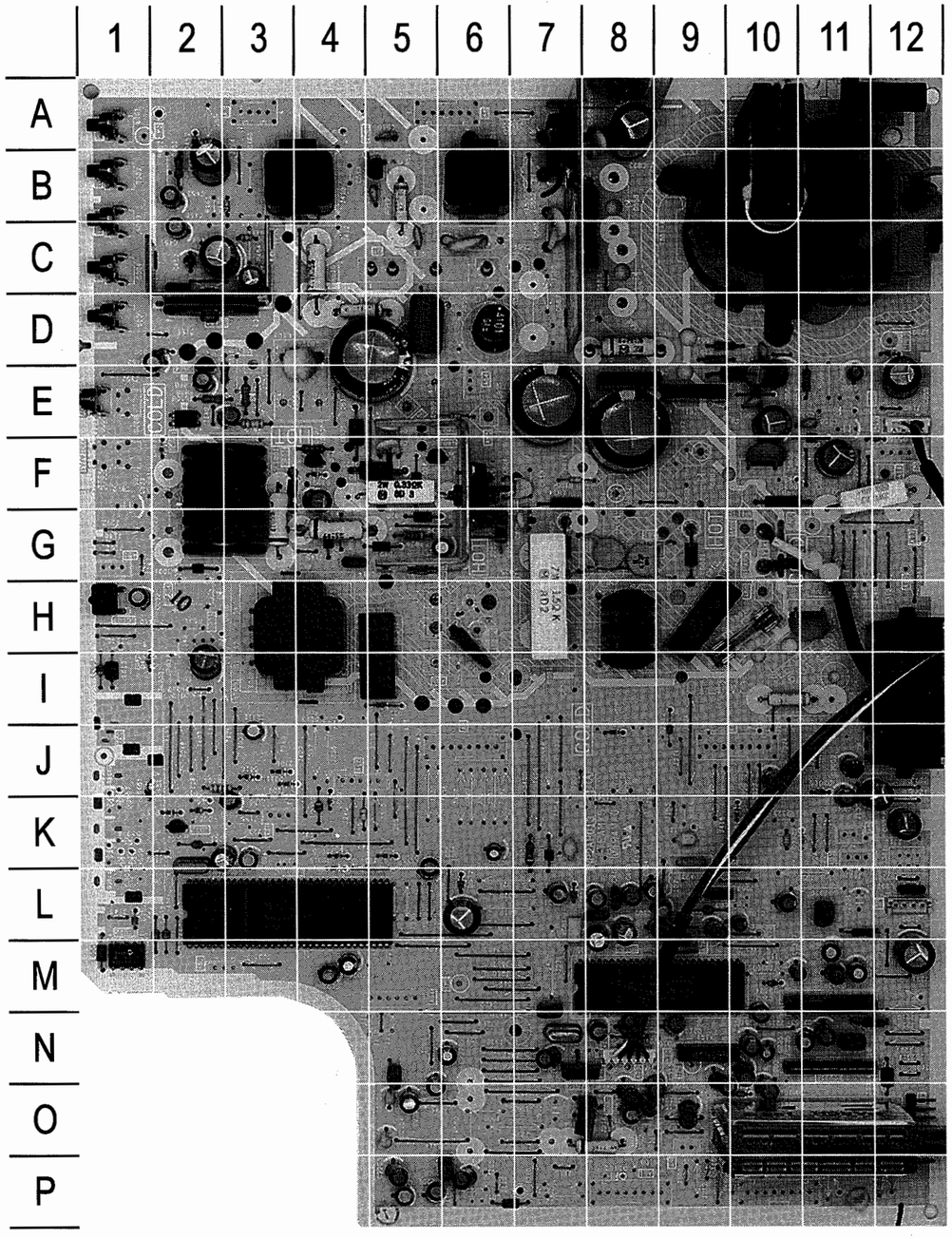
(1) USED IN MODEL CT-20G34A.

(2) USED IN MODELS CT-20G14A, CT-G2014DA, CT-20G24A, AND CT-20G24DA.

PANASONIC MODEL CT-20G4A (CHASSIS AP327)

SET 4187 Page 3

MAIN BOARD - TOP VIEW

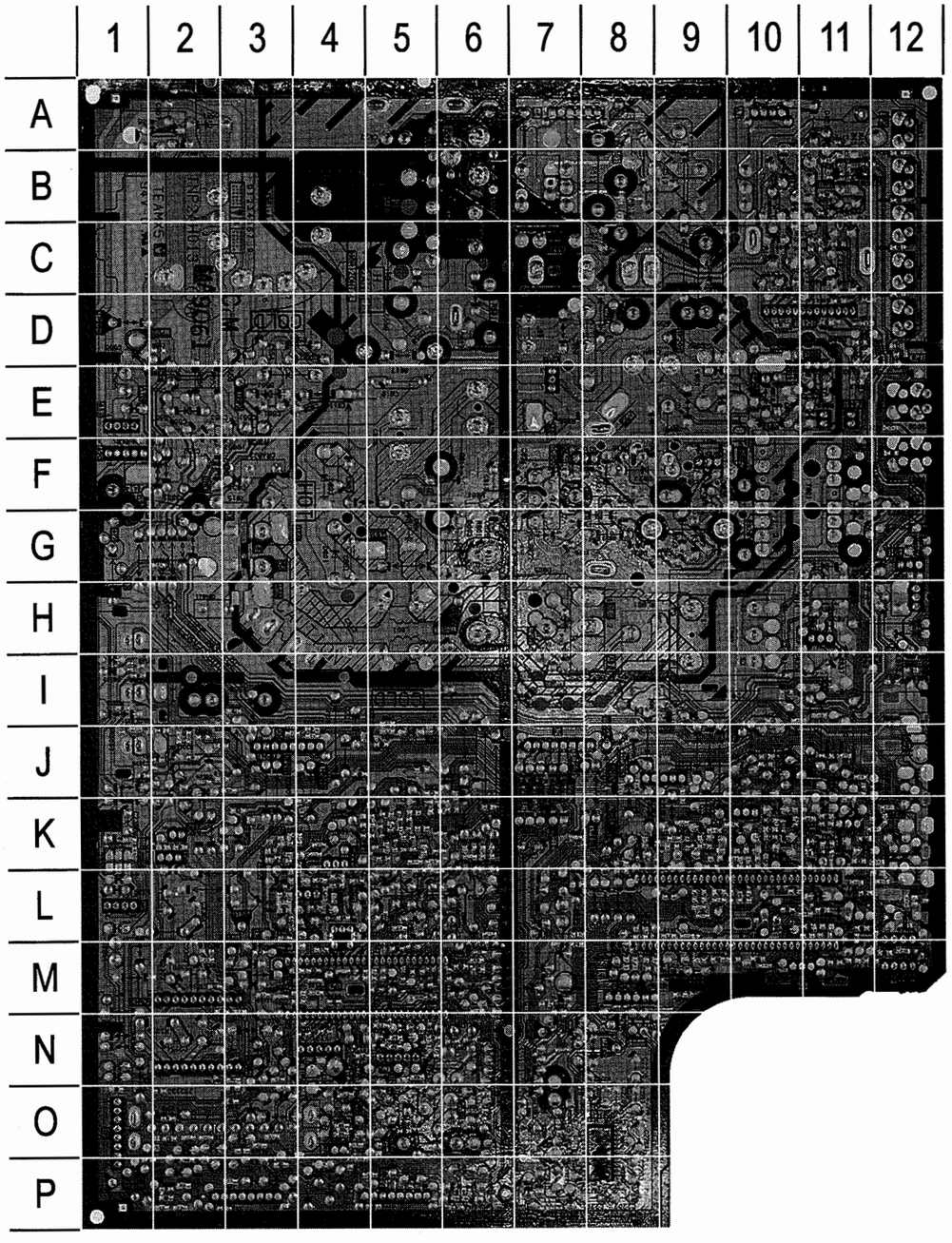


A HOWARD W. SAMS GRIDTRACE™ PHOTO

MAIN BOARD - TOP VIEW, GRIDTRACE LOCATION GUIDE

A11	N8	C561	E10	D001	G2	IC551	O8	R809	E3
A12	F12	C563	C8	D002	I5	IC552	N7	R810	E3
C001	O9	C564	C6	D003	K2	IC801	E2	R812	E3
C003	O10	C565	C7	D006	O10	IC803	G6	R815	F10
C011	K2	C566	A8	D008	K5	IC2303	M10	R817	D8
C013	K3	C569	D5	D009	K4	IC2304	N10	R820	J10
C019	K5	C571	O8	D011	J3	JK3001	I12	R822	G6
C020	M4	C572	O8	D014	K4	L001	K2	R823	G4
C022	I2	C573	N7	D015	K4	L002	P11	R824	G4
C024	K3	C606	N8	D016	J3	L003	L2	R826	F5
C026	M4	C801	G8	D017	K2	L004	L2	R827	F4
C032	H1	C802	G8	D052	L1	L006	M1	R828	G3
C102	L7	C805	E7	D451	D3	L008	I1	R829	G5
C106	L9	C806	E8	D452	A2	L009	N12	R2301	F12
C108	L10	C807	E3	D453	I1	L012	P6	R2303	L11
C109	L10	C808	E2	D461	J1	L013	I1	R2319	K10
C111	O9	C809	D5	D501	L7	L103	L9	R2353	N11
C113	N10	C810	E8	D531	K7	L104	O9	RL801	I5
C151	N10	C811	E9	D532	L6	L105	L9	S001	A1
C203	N10	C812	H9	D551	E10	L106	K9	S002	B1
C302	K7	C814	G4	D553	F11	L551	D6	S003	B1
C304	L8	C815	F4	D554	A11	L602	K7	S004	C1
C305	L9	C818	F5	D555	D12	L801	H8	S005	D1
C306	L8	C820	G6	D556	F12	L802	D4	S006	E1
C308	M7	C823	A8	D560	J8	L804	F6	SP	L12
C309	N8	C824	F7	D561	E10	L2301	L12	T002	H3
C310	N9	C825	G7	D801	G9	L2302	K4	T501	B6
C311	O8	C2201	P5	D802	G7	Q002	K2	T502	B4
C312	O8	C2202	P5	D806	D2	Q501	B5	T551	B10
C314	N5	C2203	P5	D807	F2	Q551	A7	T801	F2
C401	L8	C2204	O5	D810	H6	Q801	F5	TNR001	O11
C403	L8	C2205	O5	D820	G5	Q802	F4	TP	O12
C451	C2	C2206	N5	D821	G5	Q804	D2	TP15	O12
C452	C2	C2207	05	D822	G4	R004	J2	TPD2	D1
C453	B2	C2212	P6	D823	F5	R021	P2	X001	K2
C454	B2	C2215	P6	D824	F5	R451	B2	X101	N9
C455	C3	C2218	N5	D825	E4	R460	C3	X102	L9
C456	C2	C2220	N6	D826	F3	R469	D11	X201	K9
C459	C2	C2302	M11	D829	F4	R470	B3	X501	L7
C462	D2	C2303	M11	D2301	J3	R509	K4	X601	N7
C502	L8	C2304	L11	D2302	K11	R510	C4		
C503	L8	C2306	J12	D2312	J9	R512	B5		
C506	L8	C2307	M10	D3001	K10	R531	K7		
C510	A5	C2309	M11	D3002	N9	R551	D9		
C511	C5	C2311	J3	D3004	M10	R552	D10		
C512	B5	C2351	M12	D3005	J11	R553	E11		
C531	L7	C2352	N11	DEG	H5	R554	O8		
C532	L6	C2353	N11	DY	C5	R555	A11		
C551	E10	C2354	N11	F801	H10	R559	I10		
C552	F11	C2356	K12	FA1	O12	R563	A11		
C553	E11	C2357	N10	FA2	O12	R564	A11		
C554	D10	C3001	J11	IC001	L2	R567	D4		
C555	E12	C3002	J11	IC002	M1	R801	H7		
C556	E10	C3003	J10	IC003	H1	R805	F7		
C557	A11	CRA801	H11	IC101	M8	R806	E6		
C560	E11	CRA802	F10	IC451	D2	R808	E2		

MAIN BOARD - BOTTOM VIEW



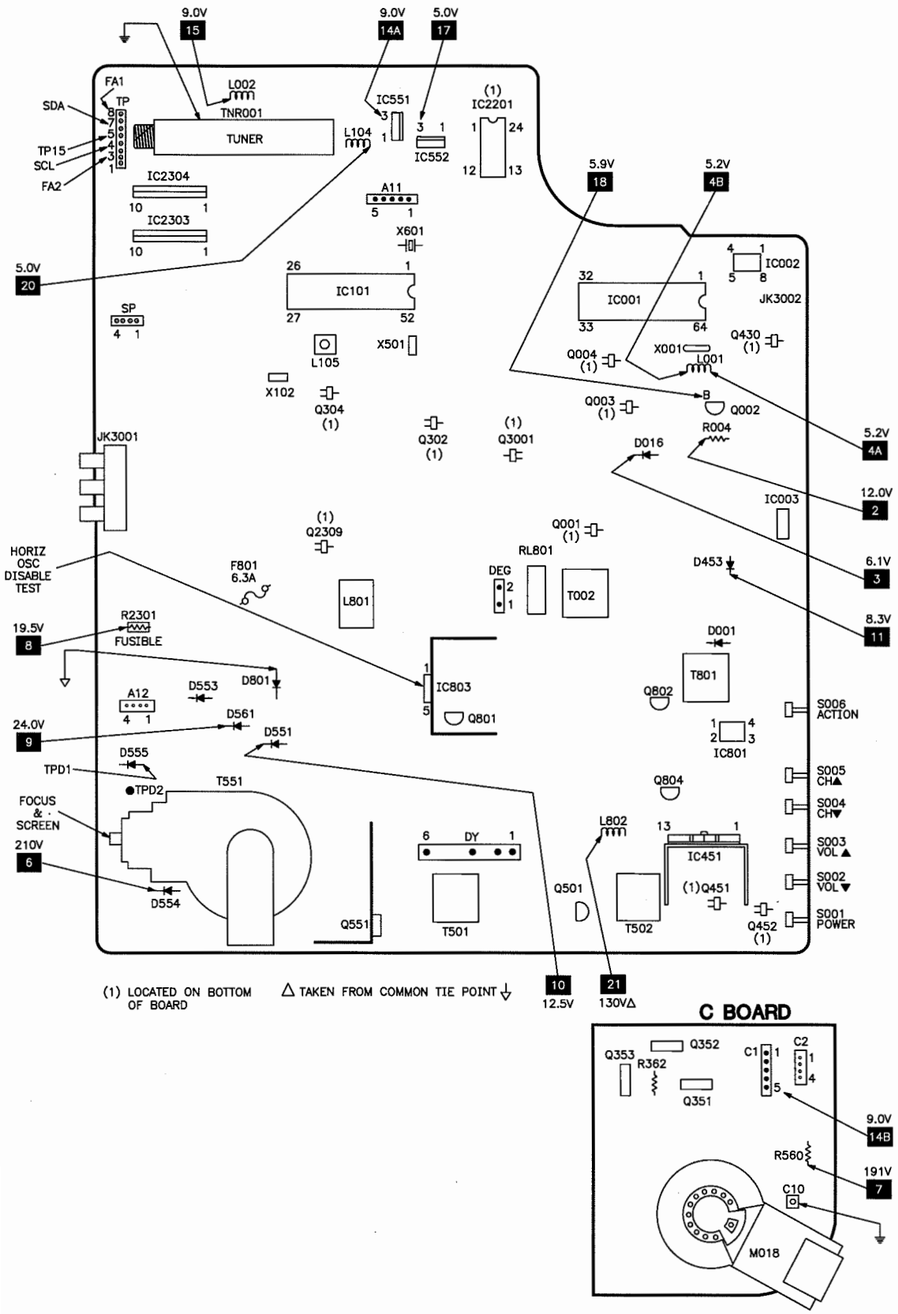
A HOWARD W. SAMS GridTrace™ PHOTO

MAIN BOARD - BOTTOM VIEW, GRIDTRACE LOCATION GUIDE

C004	O2	C2210	O8	R028	L11	R305	M3	R536	M6
C005	O2	C2310	M2	R030	K10	R306	M3	R537	M6
C008	L12	C2358	O3	R032	I12	R307	M4	R556	E2
C010	K11	C3005	J2	R033	B12	R308	O5	R557	D2
C016	K9	C3006	J2	R034	B12	R309	K6	R565	I3
C017	K11	D3016	L11	R035	C12	R310	M5	R602	N5
C018	K11	IC2201	P8	R036	D12	R311	L5	R603	N5
C025	L9	Q001	I9	R037	D12	R317	M5	R604	N5
C031	K9	Q003	K10	R038	D12	R319	L3	R614	N5
C033	L12	Q004	K8	R039	J11	R320	K6	R813	E11
C035	K9	Q302	K6	R046	I12	R401	L5	R821	F12
C036	L9	Q304	L4	R048	O4	R430	K11	R825	F8
C037	N7	Q430	K12	R049	O4	R432	K11	R2201	P8
C038	L9	Q451	B11	R053	L11	R454	D11	R2206	O7
C101	M4	Q452	B11	R055	K3	R455	C11	R2207	O7
C103	M4	Q2309	J5	R060	K10	R456	C11	R2220	P7
C105	M4	Q3001	J8	R065	K9	R457	B11	R2306	M2
C107	K4	R002	L11	R066	L9	R458	B11	R2311	K9
C110	M4	R003	L8	R067	L9	R459	C11	R2312	J10
C117	K4	R005	K11	R068	L9	R462	A10	R2313	I10
C201	L3	R006	K11	R070	M7	R463	B11	R2314	J5
C202	M3	R007	K10	R101	M4	R465	J11	R2317	M2
C301	K6	R008	K10	R102	O2	R466	I10	R2318	K3
C402	L5	R010	M9	R103	O2	R467	D11	R2321	K4
C504	L6	R011	L11	R104	L4	R468	D11	R2322	J5
C505	M5	R012	K8	R105	L4	R471	A11	R2356	N3
C507	K6	R014	K9	R107	M4	R501	K6	R3001	J4
C508	K7	R015	K9	R108	L4	R502	L6	R3002	K8
C533	M5	R016	M11	R152	O1	R503	M5	R3005	I2
C534	M6	R017	M12	R153	P2	R504	M6	R3006	J3
C601	K5	R020	L8	R154	O3	R505	M6	R3009	J2
C602	K5	R022	P2	R201	L4	R506	L6	R3010	J3
C604	O6	R023	O5	R202	M4	R507	M5	R3011	J2
C605	N6	R025	M9	R203	M5	R508	M6	R3012	J2
C2208	O8	R026	M10	R303	J5	R532	M6	TPD1	D2
C2209	O8	R027	M10	R304	K5	R533	M5		

PLACEMENT CHART

A BOARD



(1) LOCATED ON BOTTOM OF BOARD

△ TAKEN FROM COMMON TIE POINT

C BOARD

Important Parts Information

- The parts listed here are those not usually available from a well-stocked supply cabinet or bin.
- Where items may be replaced with equivalent parts, several alternates are shown from participating vendors.
- On the parts lists, safety items are marked with a # to remind you that only exact replacements are recommended for these items.
- When ordering parts, state the model number, part number, and description.

Obtaining Parts

Many of these parts are available from your local Sams authorized distributor or the manufacturer of the equipment. Call Sams for the name of your nearest distributor:

800-428-7267

Or consult the Sams *Annual Index* for the address of the original equipment manufacturer.

Participating Vendors

Information on test equipment and replacement parts is listed in these pages for the following participating vendors. Consult the Sams *Annual Index* for their current address.

- Custom Components Corporation (Chek-A-Color)
- NTE Electronics, Inc. (NTE)
- Philips ECG Company (ECG)
- Sencore, Inc.
- Terrell & Nobis (TNI Electronics)
- Thomson Consumer Electronics, Inc. (SK, TCE)

PARTS LIST

SEMICONDUCTORS

(Select the replacement that gives the best results.)

	Item No.	Type No.	Mfr. Part No.	ECG Part No.	NTE Part No.	TCE Part No.
	D001	-	ERA15-01	ECG552	NTE552	SK9000
	D002	-	MA165	ECG519	NTE519	SK3100
	D003	-	MA4047H	ECG5009A	NTE5009A	SK4A7
	D006	-	MA4330H	-	-	-
	D008, 09, 11	-	MA165	ECG519	NTE519	SK3100
	D014, 15, 16, 17	-	MA165	ECG519	NTE519	SK3100
	D052	-	MA4068M	ECG5014A	NTE5014A	SK6A8
	D451	-	ERA15-01	ECG552	NTE552	SK9000
	D452	-	MA4047M	ECG5009A	NTE5009A	SK4A7
	D453	-	MA165	ECG519	NTE519	SK3100
	D461	-	MA27WTA	-	-	-
	D501	-	MA4082L	-	-	-
#	**D531**	-	AS01	ECG552	NTE552	SK9000
#	**D532**	-	MA4062LTV	ECG5012A	NTE5012A	SK6A0
#	**D551**	RU2N	TVSRU2N	ECG552	NTE552	SK9000
#	**D553, 54**	AU02V0	AU02	ECG552	NTE552	SK9000
	D555	-	MA165	ECG519	NTE519	SK3100
	D556	-	MA4360H	-	-	-
	D560	-	MA165	ECG519	NTE519	SK3100
#	**D561**	AU02V0	AU02	ECG552	NTE552	SK9000
#	**D801, 02**	-	GP15KL-042	-	-	-
	D806	-	MA4047H	ECG5009A	NTE5009A	SK4A7
	D807	-	MA165	ECG519	NTE519	SK3100
	D820, 21, 22	EU02	EU02V1	ECG551	NTE551	SK3125A
	D823	-	RL30A	-	-	-
	D824	EU02	EU02V1	ECG551	NTE551	SK3125A
#	**D825**	TVSSR2KLV	TVSSR2KL	-	-	-
	D826	EU02	EU02V1	ECG551	NTE551	SK3125A
	D829	-	MA165	ECG519	NTE519	SK3100
	D2301, 02	-	MA165	ECG519	NTE519	SK3100
	D2312	-	MA4068M	ECG5014A	NTE5014A	SK6A8
	D3001	-	MA165	ECG519	NTE519	SK3100
	D3002 , 04, 05	-	MA4110M	-	-	-
	D3016	-	MA3056M	-	-	-
	IC001	-	MN1874085TN15	-	-	-
	IC002	24LC04BI/P	24LC04BIP	-	-	-
#	**IC101**	AN5165K	-	-	-	-
#	**IC451**	LA7837	LA7837-TV	ECG7104	NTE7104	-
#	**IC551**	-	AN78M09	ECG1910	NTE1902	SK3962
#	**IC552**	-	AN78M05	ECG960	NTE960	SK3591
#	**IC801**	0N3131R	-	ECG3098	NTE3098	SK10178
		-	PC817X2	-	-	-
#	**IC803**	-	STR58041A	ECG7078	NTE7078	-
	IC2201	-	AN5828S-E1Y	-	-	-
	IC2303, 04	-	LA4285	-	-	-
	Q001	MSD601	MSD601-RT1	-	-	-
	Q002	JC501PQ	-	ECG85	NTE85	SK3124A
		-	2SC1685QRS	ECG85	NTE85	SK9229
	Q003, 04	MSB709	-	-	-	-
		2SB709AR	2SB709ARTX	ECG2409	NTE2409	SK10100
	Q302, 04	MSD601	-	-	-	-
		2SD601A	2SD601ARTX	ECG2408	NTE2408	SK10099
	Q351, 52, 53	2SC3063RL	2SC3063	ECG157	NTE157	SK3747
	Q430, 51, 52	MSD601	-	-	-	-
		2SD601AR	2SD601ARTX	ECG2408	NTE2408	SK10099
	Q501	2SC1573A	2SC1573AH	ECG399	NTE399	SK9352
#	**Q551**	2SD2499	2SD2499MA2	-	-	-
	Q801, 02	2SC1685RS	2SC1685RSTA	ECG85	NTE85	SK9229
	Q804	-	2SA1767Q	-	-	-
	Q2309	MSB709	-	-	-	-
		2SB709AR	2SB709ARTX	ECG2409	NTE2409	SK10100
	Q3001	MSD601	-	-	-	-
		2SD601	2SD601ARTX	ECG2408	NTE2408	SK10099

 # For SAFETY use only equivalent replacement part.

PARTS LIST continued

CONTROLS & RESISTORS

	Item No.	Function/Rating	Mfr. Part No.	NTE Part No.
#	**D810**	5 Cold PTC	TAP104XM05	-
#	**R028**	10K 5% 1/10W	ERJ6GEYJ103	-
	R032	10K 1% 1/10W	ERJ6ENF1002	-
	R305	3000 1% 1/4W	ER0S2CKF3001	-
	R306	1650 1% 1/10W	ERJ6ENF1651	-
#	**R510**	2700 5% 3W	ERG3FJS272H	3W227
#	**R531**	47 5% 1/4W	ERD25FJ470	QW047
#	**R532** (1)	45.3K 1% 1/10W	ERJ6ENF4532	-
#	**R532** (2)	47K 1% 1/10W	ERJ6ENF4702	-
#	**R533**	15K 1% 1/10W	ERJ6ENF1502	-
#	**R551, 52, 53**	1 5% 1/2W	ERDS1FJ1R0	HW1D0
#	**R555**	100 5% 1/2W	ERDS1TJ101	HW110
#	**R558** (1)	2.0 5% 2W Fusible	ERQ2CJP2R0	F2W2D0
#	**R558** (2)	2.2 5% 2W Fusible	ERQ2CJP2R2	F2W2D2
#	**R801**	1.5 10% 7W Wirewound	ERF7ZK1R5	-
#	**R815**	8.2M 20% 1/2W	ERC12ZGM825	HW582
#	**R817**	4.7 5% 3W	ERX3FJ4R7	3W4D7
	R824	68 5% 3W	ERG3FJ680	-
#	**R826**	.33 10% 2W	ERF2AKR33	2WD33
	R828	47 5% 3W	ERG3FJ470H	3W047
	R829	27 5% 1/4W Fusible	ERQ14AJ270	-
	R2301	12 5% 2W Fusible	ERQ2CJP120	F2W012

 # For SAFETY use only equivalent replacement part.
(1) Used in models CT-20G4A and CT-2013SA.
(2) Used in models CT-20G14A, CT-20G14DA, CT-20G24A, CT-24G24DA, and CT-20G34A.

CAPACITORS & ELECTROLYTICS

	Item No.	Rating	Mfr. Part No.
	C304	.47µF 50V NP	ECEA1HNR47U
	C354	.001 10% 2kV	ECKD3D102KB
	C452	1µF 25V Tantalum	ECSF1EE105
#	**C531**	22µF 25V	ECA1EM220
#	**C532**	1000µF 10V	ECA1AM102
#	**C551**	330µF 35V	ECA1VM331
#	**C552**	470µF 25V	ECA1EM471
#	**C555**	22µF 250V	ECA2EM220
#	**C556**	470µF 16V	ECA1CM471
#	**C560**	2.2µF 25V	EEANA1E2R2B
#	**C563**	.0082 5% 1.2kV	ECWH12H822JS
#	**C564, 65** (1)	.001 5% 2kV	ECKD3D102JB
#	**C564, 65** (2)	820pF 5% 2kV	ECKD3D821JB
#	**C566**	180pF 5% 2kV	ECKD3D181JB
#	**C569**	.39 5% 250V	-
		.39 5% 200V	ECWF2394JBB
#	**C801, 02**	.0047 +100% -0% 250V	ECKDAE472ZED
#	**C805, 06, 09**	150µF 200V	EC0S2DG151DG
#	**C810, 11**	.015 20% 250VAC	ECQU2A153MV
#	**C812**	.22 20% 250VAC	ECQU2A224MV
	C818	820pF 10% 1kV	ECKD3A821KB
#	**C820**	10µF 63V	ECA1JHG100B
#	**C823**	33µF 160V	ECEA160V33UE
	C824	330pF 10% 1kV	ECKD3A331KB
	C825	470pF 10% 1kV	ECKD3A471KB
	C2204	10µF 16V Tantalum	AP106K016CAE
	C2207	3.3µF 16V Tantalum	AP335K016CAE

 # For SAFETY use only equivalent replacement part.
(1) Used in models CT-20G4A and CT-2013SA.
(2) Used in models CT-20G14A, CT-20G14DA, CT-20G24A, CT-24G24DA and CT-20G34A.

COILS & TRANSFORMERS

	Item No.	Function/Rating	Mfr. Part No.
#	**DEG**	Degaussing	TSP2AA008
#	**DY** (1)	Yoke Horiz 2.4mH Vert 19.5mH	TLY2AA001
#	**DY** (2)	Yoke	TLY2AA010
	L001	2.2µH	TLTABT2R2K
	L002	39µH	ELESN390KA
	L003, 04	2.2µH	TLTABT2R2K
	L006	Ferrite Bead	EXCELSA24T
	L008	47µH	TLTABT470K
	L009	Ferrite Bead	EXCELSA35
	L012	Ferrite Bead	EXCELSA24T
	L013	Ferrite Bead	EXCELSA35
	L103	12µH	TLTAB120K
	L104	1.0µH	TLTABT1R0K
	L105	VCO	EIV7EN053B
	L106	18µH	ELESN180JA
#	**L551**	Horizontal Linearity	ELH5L4101
	L602	12µH	ELESN120JA
#	**L801**	Line Filter	ELF15N013A
	L802	68µH	ELEIE680KA
	L804	Ferrite Bead	EXCELSA39
	L2301	Ferrite Bead	EXCELDR25C
	L2302	4.7µH	TLTABT4R7K
#	**T002**	Power	TLP16297
#	**T501**	Horizontal Driver	ETH19Y70AYM
#	**T502**	Horizontal Coupling	ETE19Z30AY
#	**T551** (3)	Horizontal Output	KFT3AB119F
#	**T801**	SMT	ETS25AD129NC

 # For SAFETY use only equivalent replacement part.
(1) Used in models CT-20G4A and CT-2013SA
(2) Used in models CT-20G14A, CT-14G24DA, CT-20G24A, CT-24G24DA, and CT-20G34A.
(3) Screen and Focus controls are part of T551.

CABINET PARTS

Item	Mfr. Part No.
Model CT-20G4A	
Badge (Panasonic)	TBM2A10141
Button, 7 Key	TBX2AA00201G
Cabinet Front	TXFKY01SER
Cabinet Rear	TKUA22211M
Remote Guide	TQB2AA7035
Transmitter	
Battery Cover	UR50EC1151A
Model CT-20G14A	
Badge (Panasonic)	TBM2A10141
Button, 7 Key	TBX2AA00301G
Cabinet Front	TXFKY05ASER
Cabinet Rear	TXFKU0897SER
Remote Guide	TQB2AA7035
Transmitter	
Battery Cover	UR50EC1151A
Model CT-20G14DA	
Badge (Panasonic)	TBM2A10141
Button, 7 Key	TBX2AA00301G
Cabinet Front	TXFKY05ASER
Cabinet Rear	TXFKU02ASER
Remote Guide	TQB2AA7035
Transmitter	
Battery Cover	UR50EC1151A
Model CT-20G24A	
Badge (Panasonic)	TBM2A10141
Button, 7 Key	TBX2AA00301G
Cabinet Front	TXFKY05ASER
Cabinet Rear	TXFKU03ASER
Pushbutton Speaker	TBX1886601
Remote Guide	TQB2AA7037
Transmitter	
Battery Cover	UR51EC883A
Model CT-20G24DA	
Badge (Panasonic)	TBM2A10141
Button, 7 Key	TBX2AA00301G
Cabinet Front	TXFKY05ASER
Cabinet Rear	TXFKU03ASER
Pushbutton Speaker	TBX1886601
Remote Guide	TQB2AA7037
Transmitter	
Battery Cover	UR51EC883A

CABINET PARTS continued

Item	Mfr. Part No.
Model CT-20G34A	
Badge (Panasonic)	TBM2A10141
Button Keyboard	TBX2A50153
Cabinet Front	TXFKY06ASER
Cabinet Rear	TXFKU06ASER
Pushbutton Speaker	TBX1886601
Remote Guide	TQB2AA7037
Transmitter	
Battery Cover	UR51EC883A
Model CT-2013SA	
Badge (Panasonic)	TBM2A10141
Button, 7 Key	TBX2AA00201G
Cabinet Front	TXFKY01SER
Cabinet Rear	TKUA22211M
Remote Guide	TQB2AA7035
Transmitter	
Battery Cover	UR50EC1151A

MISCELLANEOUS

	Item No.	Description	Mfr. Part No.	Notes
#	**CRA801, 02**	Capristor	EXNFGV	-
#	**F801**	Fuse	XBA2A00101	6.3Amp, 125V
	IC003	Receiver	RPM-637CBRS1	Remote
	JK3001 (6)(8)	Jack	TJB2A9064B	Assembly
	JK3001 (4)(7)	Jack	TJB2A9063B	Assembly
	JK3002 (7)(8)	Jack	TJB2AA0031	Assembly
#	**M001** (6)	CRT	A51KRE89XDT	A51KRE89X
#	**M002** (5)	CRT	A51KQN011X	-
#	**M018**	Socket	TJSC00300	CRT
#	**M038**	Line Cord	TSX2AA0111	AC, Polarized
#	**RL801**	Relay	TSEH0005	Power
	S001 (3)	Switch	EVQPF106K	Power
	S001 (2)	Switch	EVQQKH06K	Power
	S002 (3)	Switch	EVQPF106K	Volume Down
	S002 (2)	Switch	EVQQKH06K	Volume Down
	S003 (3)	Switch	EVQPF106K	Volume Up
	S003 (2)	Switch	EVQQKH06K	Volume Up
	S004 (3)	Switch	EVQPF106K	Channel Down
	S004 (2)	Switch	EVQQKH06K	Channel Down
	S005 (3)	Switch	EVQPF106K	Channel Up
	S005 (2)	Switch	EVQQKH06K	Channel Up
	S006 (2)(4)	Switch	EVQQKH06K	Action
	S007 (4)	Switch	EVQQKH06K	TV/Video
	S008 (3)	Switch	EVQPF106K	Action
	S009 (3)	Switch	EVQPF106K	TV/Video
	S2301	Switch	ESB621283	Speaker
	SP1, SP2 (4)	Speaker	EAGG1202B2	-
	SP1, SP2 (3)(6)	Speaker	TAS2AA0012	2" X 3 1/2" 16 Ohm, 1.5W
	TNR001 (1)	Tuner	ENV56D37G3R	UHF/VHF
	X001	Crystal	TSS2080MX	12MHz
	X101	Filter	M1969M	SAW
	X102	Trap	EFCWS4504AB	4.5MHz
	X201	Filter	SFSH4R5MDB	4.5MHz
	X501	Crystal	TAFCSB503F38	503kHz
	X601	Crystal	TSS2AA001	3.58MHz
		Magnet	0FMK014ZZ	Correction Strip
		PC Board (6)	TNP2AH013CM	A
		PC Board (7)	TNP2AH013CA	A
		PC Board (4)	TNP2AH013CB	A
		PC Board (8)	TNP2AH013CC	A
		PC Board (3)(4)	TNP2AA046AB	C
		PC Board (6)	TNP2AA046AD	C
		Transmitter (6)(8)	EUR501371	Remote
		Transmitter (7)(4)	EUR511112	Remote
		Wedge	TMM2A30702	Yoke Positioning (3 Used)

 # For SAFETY use only equivalent replacement part.
(1) Contact TNI Electronics for replacement; order by manufacturer's part number.
(2) Used in models CT-20G4A and CT-2013SA.
(3) Used in models CT-20G14A, CT-20G14DA, CT-20G24A, and CT-24G24DA.
(4) Used in model CT-20G34A.
(5) Used in models CT-20G14A, CT-20G14DA, CT-20G24A, CT-24G24DA, and CT-20G34A.
(6) Used in models CT-2013SA and CT-20G4A.
(7) Used in models CT-20G24A and CT-20G24DA.
(8) Used in models CT-20G14A and CT-20G14DA.

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